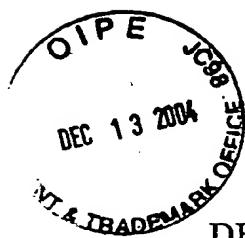


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DECLARATION

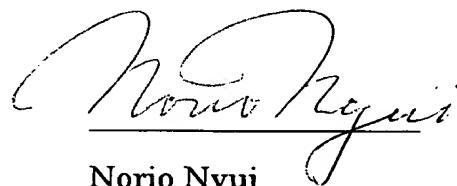
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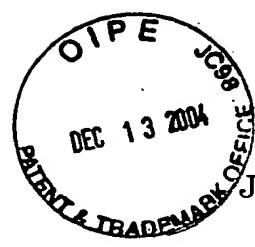
Technology Center 2100

I, Norio Nyui, a national of Japan, 2-2-1-416, Kita, Kunitachi-shi, Tokyo, Japan, declare that I am familiar with both the English and Japanese languages, that I am the translator of the attached document, that to the best of my knowledge and belief the attached document is a true and accurate translation of Japanese Patent Application No. 2001-026825 filed on February 2, 2001, and further that these statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Dated this 1st day of Dec., 2004



Norio Nyui



JAPAN PATENT OFFICE

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This is to certify that the annexed is a true copy of the following application as filed with this Office.

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Application Number: Japanese Patent Application 2001-026825

Applicant(s): Hitachi Ltd.

July 5, 2001

Commissioner,  
Japan Patent Office

Kozo OIKAWA (Seal)

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[Filing Date] February 2, 2001  
[Address] To the Commissioner of the Patent Office  
[International Patent Classification] G06F 15/16  
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**Identification No.** [000005108]

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[List of Attached Documents]

15 [Document's Name] Specification 1

[Document's Name] Drawings 1

[Document's Name] Abstract 1

[Proof] Requested

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Specification

[Title of the Invention]

5 Computing System

[Claim]

[Claim 1]

A computing system in which a plurality of OSs run on  
10 hardware of one computer, said computing system comprising:

management agents that are respectively executed on the OSs,  
to manage said OSs;

a partitioning control unit that keeps partition configuration  
information indicating a relation between each OS and the hardware,  
15 and controls allocation of the hardware to each OS; and

a hardware data collection unit that collects data on said  
hardware;

wherein:

said computing system uses said partition configuration  
20 information to perform hardware management for each OS.

[Claim 2]

The computing system according to Claim 1, further  
comprising:

25 a management console for performing data collection, failure  
reception and control of said computer on which said plurality of OSs  
run.

[Claim 3]

- The computing system according to Claim 2, wherein:
- when one of said management agents receives a request of said management console for acquisition of hardware configuration information, the management agent notifies said request to said partitioning control unit;
- the partitioning control unit, which has been notified of said request, acquires the data on said hardware from said hardware data collection unit, and extracts requested data on hardware using said partition configuration information, to send said data extracted to said management agent; and
- said management agent notifies the data received from said partitioning control unit to said management console.

15 [Claim 4]

- The computing system according to Claim 2, wherein:
- when said hardware data collection unit detects an occurrence of a failure in a piece of the hardware, the hardware data collection unit notifies failure information to said partitioning control unit;
- said partitioning control unit notifies said failure information to a management agent corresponding to an OS allocated with said piece of the hardware in which the failure has occurred; and
- said management agent notified of said failure information, in turn, notifies said failure information to said management console.

25

[Claim 5]

- The computing system according to Claim 1, wherein:
- when said hardware data collection unit detects an occurrence

of a failure in a piece of the hardware, the hardware data collection unit notifies failure information to said partitioning control unit;

said partitioning control unit notifies said failure information to a management agent corresponding to an OS allocated with said 5 piece of the hardware in which the failure has occurred; and

said management agent notified of said failure information controls software, based on the failure information notified.

[Claim 6]

10 The computing system according to Claim 1, wherein:

when one of said management agents detects an occurrence of a failure in software, said management agent notifies failure information to said partitioning control unit;

15 said partitioning control unit performs control of reallocation of the hardware allocated to each OS, or performs activation control for each OS, based on said failure information.

[Claim 7]

A computing system in which a plurality of OSs run on 20 hardware of one computer, said computing system comprising:

an integrated management agent that is executed on a first OS to manage said computer;

25 software management agents that are respectively executed on the OSs except for said first OS, to each manage software executed on an OS concerned;

a partitioning control unit that keeps partition configuration information indicating a relation between each OS and the hardware, and controls allocation of the hardware to each OS; and

a hardware data collection unit that collects data on said hardware;

wherein:

said computing system uses said partition configuration information to perform hardware management for each OS.

[Claim 8]

The computing system according to Claim 7, further comprising:

10 a management console for performing data collection, failure reception and control of said computer on which said plurality of OSs run.

[Claim 9]

15 The computing system according to Claim 8, wherein:

when said integrated management agent receives a request of said management console for acquisition of hardware configuration information, said integrated management agent notifies said request to said partitioning control unit;

20 the partitioning control unit, which has been notified of said request, acquires the data on said hardware from said hardware data collection unit, and extracts requested data on hardware using said partition configuration information, to send said data extracted to said integrated management agent; and

25 said integrated management agent notifies the data received from said partitioning control unit to said management console.

[Claim 10]

The computing system according to Claim 7, wherein:  
when said hardware data collection unit detects an occurrence  
of a failure in the hardware, the hardware data collection unit notifies  
failure information to said partitioning control unit;  
5           said partitioning control unit notifies said failure information  
to said integrated management agent; and  
              said integrated management agent controls software, based on  
the failure information notified.

10 [Claim 11]

The computing system according to Claim 7, wherein:  
when one of said software management agents detects an  
occurrence of a failure in software, said software management agent  
notifies failure information to said partitioning control unit;  
15           said partitioning control unit performs control of reallocation  
of the hardware allocated to each OS, or performs activation control for  
each OS, based on said failure information.

[Description of the Invention]

20

[0001]

[Field of Industrial Application]

The present invention relates to a computing system such as a  
virtual machine, a logical partitioning computer, a physical  
25 partitioning computer, or the like, and, in particular, to configuration  
management, failure monitoring and control of internal hardware  
resources in such a computing system.

[0002]

[Prior Art]

Conventionally, important work such as basic business work utilizes a mainframe-type computer. Generally, a mainframe-type computer comprises particular hardware architecture and a particular operating system oriented to that particular architecture. Configuration management, failure monitoring and control of hardware resources in such a mainframe-type computer are realized through a special monitoring apparatus or terminal provided separately from the main body of the computer. Usually, an administrator uses a management console connected to a network, in order to manage, monitor and control internal hardware resource data collected by the special monitoring apparatus etc.

15 [0003]

The reason why thus-described configuration is employed for management, monitoring and control of hardware resources in a mainframe-type computer is as follows. Namely, a mainframe-type computer is used for important work such as basic business work, and is important from the viewpoint of a system, and accordingly it is necessary to prepare a special monitoring apparatus or the like separately from the main body of the computer. On the other hand, it is easy to prepare a special monitoring apparatus, since the number of computers under administration is small.

25

[0004]

Further, in the field of mainframe-type computers, there has been conventionally known a computing system, such as a virtual

machine, a logical partitioning computer, physical partitioning computer, or the like, in which a plurality of operating systems run in parallel in one computer. Also in such a computing system, configuration management and the like of hardware resources are

- 5 realized similarly to a computing system in which a single operating system runs. Conventional examples of virtual machine are described in Japanese Unexamined Patent Laid-Open Nos. 9-171475 and 8-227406, etc., for example.

10 [0005]

On the other hand, an open-type computer, which includes open hardware architecture such as a personal computer, workstation, or the like and a general purpose operating system oriented to that architecture, has not been rarely used for basic business work, owing 15 to performance of the computer itself. Further, it is very rare to employ a computing system's configuration in which a plurality of operating systems run. Further, generally, a system constructed by open-type computers includes more computers than a system constructed by mainframe-type computers, and accordingly, it is not 20 easy to provide a special monitoring apparatus or the like for each computer.

[0006]

Accordingly, in an open-type computer, usually, a management 25 agent that operates on an operating system performs configuration management, failure monitoring and control of hardware resources within a computer, and an administrator uses a management console via a network, to manage, monitor and control data on the hardware

resources within the computer. Further, to cope with a fatal hardware failure, a certain server-type computer is sometimes provided with an apparatus for managing, monitoring and controlling hardware resources of the main body. In many cases, such an apparatus is

- 5 implemented by a relatively simple add-in board or the like that can be housed in the main body. As such a conventional example, may be mentioned Japanese Unexamined Patent Laid-Open No. 9-50386, for example.

10 [0007]

[Problems to be Solved by the Invention]

Recently, however, performance difference between a mainframe-type computer and an open-type computer is reduced, and, in much more cases, open-type computers are used as a central system  
15 for basic business work. Further, concerning management of computers, it is desired to integratedly manage computers without discriminating between the mainframe type and the open type. Further, for accommodation to basic business work, it is desired, also in the case of using open-type computers, to realize a computing  
20 system having a configuration in which a plurality of operating systems run.

[0008]

As described above, the conventional mainframe-type management system presupposes that a special monitoring apparatus exists for management, monitoring and control of hardware resources. On the other hand, in many cases, an open-type computer system does not have a special monitoring apparatus or the like, since the system

includes many computers. Even if a special monitoring apparatus exists, its management function is simplified in many cases. Namely, a management configuration similar to a mainframe-type computer system has not been realized. Further, with respect to an open-type computer system, a configuration for management of hardware resource of a computing system in which a plurality of operating systems run has not been even investigated.

[0009]

10 An object of the present invention is to provide a hardware resource management system for an open-type computer system that employs a computing system configuration in which a plurality of operating systems run.

15 [0010]

**[Means to Solve the Problems]**

The present invention provides a computing system in which a plurality of OSs run on hardware of one computer, said computing system comprising: management agents that are respectively executed 20 on the OSs, to manage said OSs; a partitioning control unit that keeps partition configuration information indicating a relation between each OS and the hardware, and controls allocation of the hardware to each OS; and a hardware data collection unit that collects data on said hardware; wherein: said computing system uses said partition 25 configuration information to perform hardware management for each OS.

[0011]

In that case, it is possible to further provide a management console for performing data collection, failure reception and control of said computer on which said plurality of OSs run.

5 [0012]

Further, it is possible to provide arrangement wherein: when one of said management agents receives a request of said management console for acquisition of hardware configuration information, the management agent notifies said request to said partitioning control unit; the partitioning control unit, which has been notified of said request, acquires the data on said hardware from said hardware data collection unit, and extracts requested data on hardware using said partition configuration information, to send said data extracted to said management agent; and said management agent notifies the data received from said partitioning control unit to said management console.

[0013]

Further, it is possible to provide arrangement wherein: when said hardware data collection unit detects an occurrence of a failure in a piece of the hardware, the hardware data collection unit notifies failure information to said partitioning control unit; said partitioning control unit notifies said failure information to a management agent corresponding to an OS allocated with said piece of the hardware in which the failure has occurred; and said management agent notified of said failure information, in turn, notifies said failure information to said management console. Or, said management agent may control software, based on the failure information notified.

[0014]

Further, it is possible to provide arrangement wherein: when one of said management agents detects an occurrence of a failure in  
5 software, said management agent notifies failure information to said partitioning control unit; said partitioning control unit performs control of reallocation of the hardware allocated to each OS, or performs activation control for each OS, based on said failure information.

10

[0015]

The present invention provides another computing system comprising: an integrated management agent that is executed on a first OS to manage a computer; software management agents that are respectively executed on the OSs except for said first OS, to each manage software executed on an OS concerned; a partitioning control unit that keeps partition configuration information indicating a relation between each OS and the hardware, and controls allocation of the hardware to each OS; and a hardware data collection unit that collects data on said hardware; wherein: said computing system uses said partition configuration information to perform hardware management for each OS.  
20

[0016]

25 In that case, it is possible to further provide a management console for performing data collection, failure reception and control of said computer on which said plurality of OSs run.

[0017]

Further, it is possible to provide arrangement wherein: when said integrated management agent receives a request of said management console for acquisition of hardware configuration information, said integrated management agent notifies said request to said partitioning control unit; the partitioning control unit, which has been notified of said request, acquires the data on said hardware from said hardware data collection unit, and extracts requested data on hardware using said partition configuration information, to send said data extracted to said integrated management agent; and said integrated management agent notifies the data received from said partitioning control unit to said management console.

[0018]

Further, it is possible to provide arrangement wherein: when said hardware data collection unit detects an occurrence of a failure in the hardware, the hardware data collection unit notifies failure information to said partitioning control unit; said partitioning control unit notifies said failure information to said integrated management agent; and said integrated management agent notifies the received failure information to said management console, or, the integrated management agent may control software through said software management agents, based on the failure information notified.

25 [0019]

Further, it is possible to provide arrangement wherein: when one of said software management agents detects an occurrence of a failure in software, said software management agent notifies failure

information to said partitioning control unit; said partitioning control unit performs control of reallocation of the hardware allocated to each OS, or performs activation control for each OS, based on said failure information.

5

[0020]

Further, in the above-described computing system, it is possible to provide arrangement wherein: said partitioning control unit performs control of reallocation of the hardware allocated to each OS, or performs activation control for each OS, based on said failure information, according to an instruction of said management console.

[0021]

[Working Examples]

15 Now, embodiments of the present invention will be described in detail referring to the drawings. In the following description and in the legends in the drawings, for the sake of convenience of description, a computing system in which a plurality of operating systems (hereinafter, referred to as OS) run is called as a partitioning enabled system, and a computing system in which a single OS runs is called as a partitioning disabled system.

20 [Working Example 1]

Fig. 1 is a diagram showing an example of configuration of a computing system to which the present invention is applied.

25

[0022]

As shown in the figure, this computing system comprises a management console 10, an open-type partitioning enabled system 20,

an open-type partitioning disabled system 30, a mainframe-type partitioning enabled system 40, and a mainframe-type partitioning disabled system 50.

5 [0023]

The management console 10 is a managing computer in the present computing system, and, on the other hand, the open-type partitioning enabled system 20, the open-type partitioning disabled system 30, the mainframe-type partitioning enabled system 40 and the mainframe-type partitioning disabled system 50 are managed computers as objects of the management by the management console 10.

[0024]

15 The management console 10 is connected to a plurality of managed computers 20 – 50, through a network 60. The network 60 is realized by a local area network (LAN), a wide area network (WAN), dedicated lines, telephone lines, a wireless network, a wired network, or the like, for example.

20

[0025]

In the figure, for the simplicity of illustration, one computer is shown for each system 20 – 50. However, a plurality of computers may exist as computers of each kind of system.

25

[0026]

The management console 10, which provides a user interface for an administrator to perform configuration management, failure

monitoring and control of the hardware of each managed computer, receives a request of the administrator and performs that request.

[0027]

5       The open-type partitioning enabled system 20 is a partitioning enabled system realized by an open-type computer, and the mainframe-type partitioning enabled system 40 is a partitioning enabled system realized by a mainframe-type computer.

10      [0028]

Each of the partitioning enabled systems 20 and 40 comprises one computer provided with an environment that enables a plurality of OSs to run, and, in each partitioning enabled system, a plurality of OSs run. As examples of the partitioning enabled system, may be 15 mentioned a virtual machine, a logical partitioning computer, and a physical partitioning computer.

[0029]

The open-type partitioning disabled system 30 is a partitioning 20 disabled system realized by an open-type computer, and the mainframe-type partitioning disabled system 50 is a partitioning disabled system realized by a mainframe-type computer.

[0030]

25      Each of the partitioning disabled systems 30 and 50 comprises one computer provided with an environment that enables one OS to run, and, in each partitioning disabled system, one OS runs.

[0031]

In the present embodiment, the management console 10 can control all kinds of computing systems 20 – 50 connected through the network 60. Namely, each system 20 – 50 provides a management interface that is similar from the viewpoint of the management console 10, and accordingly, the management console 10 can manage those computing system integratedly.

[0032]

10 In the following, a hardware resource management system in the open-type partitioning enabled system 20 will be described in detail.

[0033]

15 Fig. 2 is a diagram showing a configuration of the open-type partitioning enabled system 20. This figure shows a configuration required for performing configuration management, failure monitoring and control of the hardware resources. As shown in the figure, the open-type partitioning enabled system 20 comprises a plurality of 20 partitions 211 (A - N), a partitioning control unit 221, and hardware 231.

[0034]

25 Each of the partitions 211 is a unit in which one OS runs, and comprises one OS 2110, and a management agent 2111 that operates on the OS 2110.

[0035]

The management agent 2111 communicates with the management console 10 through the network 60, and performs configuration management, failure monitoring and control of the open-type partitioning enabled system 20. The management agent 5 2111 is realized, for example, as software (a program) that operates on the OS 2110.

[0036]

As shown in the figure, the management agent 2111 comprises 10 an external communication unit 21111, a failure information management unit 21112, a log file 21113, a software failure monitoring unit 21114, and a communication unit with partitioning control unit 21115.

15 [0037]

The external communication unit 21111 provides a communication interface (I/F) with the management console 10. The log file 21113 records failure information of each partition. The failure information management unit 21112 manages the log file 21113, 20 and, for example, notifies the management console 10 or the partitioning control unit 221 of failure information. The software failure monitoring unit 21114 detects a software failure generated in each partition. The communication unit with partitioning control unit 21115 provides a communication I/F with the partitioning control unit 25 221.

[0038]

Further, the partitioning control unit 221 controls allocation of

the hardware of one computer to respective OSs of the partitions 211, in the partitioning enabled system. The partitioning control unit 221 is realized, for example, as firmware (a program).

5 [0039]

As shown in the figure, the partitioning control unit 221 comprises partition configuration information 2211, a communication relay unit 2212, and a partition configuration management unit 2213.

10 [0040]

The partition configuration information 2211 is information that indicates correspondence between each partition 211 and the hardware 231, and includes physical configuration allocation, allocation related to resources such as interrupt addresses and memory, 15 and the like. Details of the partition configuration information 2211 will be described below.

[0041]

The communication relay unit 2212 utilizes the partition 20 configuration information 2211 and relays communication between each partition 211 and the hardware 231. Further, the communication relay unit 2212 relays an instruction from, for example, the management agent 2111 to the partition configuration management unit 2213, in order to perform dynamic change control of the hardware 25 allocated to each partition 211, and to perform activation control such as activation, shutdown, forced shutdown, etc. of the OS 2110 on each partition 211.

[0042]

The partition configuration management unit 2213 performs control of each partition 211, as well as management (such as update) of the partition configuration information 2211 in accordance with an 5 instruction through the management agent 2111, a direct instruction from the administrator by use of a local input device, or the like.

[0043]

Further, the hardware 231 is hardware of the computer 10 constituting the open-type partitioning enabled system 20, and comprises a main body hardware group 2311.

[0044]

As shown in the figure, the main body hardware group 2311 15 includes hardware such as a processor 23112, a processor temperature sensor 23113, a processor fan 23114, a memory 23115, an input/output device 23116, a power supply 23117, a power supply fan 23118, a voltage sensor 23119, a chassis fan 23120, a chassis temperature sensor 23121, and the like.

20

[0045]

The main body hardware group 2311 further comprises a hardware data collection unit 23111. The hardware data collection unit 23111 manages configuration information of each piece of 25 hardware included in the main body hardware group 2311, and monitors the conditions of each sensor device and each piece of hardware, to detect a hardware failure.

[0046]

Further, the hardware 231 comprises a service processor 2313, if necessary. The service processor 2313 is an extended device that can cooperate with the hardware data collection unit 23111 to perform configuration management, failure monitoring and control of the main body hardware group 2311. And, the service processor 2313 comprises a processor, a power supply or storage battery, a storage, a communication I/F, a timer, input/output devices, and the like, differently from the main body hardware group 2311. By providing the service processor 2313, which is a device independent of the main body of the open-type partitioning enabled system 20, it becomes possible to perform processing such as notification of failure information when a fatal failure (for example, a stop of the main body or operating system) is generated in the main body of the open-type partitioning enabled system 20, or to perform power control of the main body of the open-type partitioning enabled system 20.

[0047]

Next, details of the above-mentioned partition configuration information 2211 will be described.

[0048]

Fig. 3 is a diagram showing an example of structure of the partition configuration information 2211.

25

[0049]

As shown in the figure, the partition configuration information 2211 comprises: a processor number 221101, a processor mode 221102,

and a sharing ratio 221103, as data on a processor; a memory slot number 221104, a total memory size 221105, a dedicated memory size 221106, a shared memory size 221107, and a shared partition name 221108, as data on a memory; and an input/output device allocation  
5 condition 221109 as data on input/output devices.

[0050]

The processor number 221101 is data indicating a physical position of a processor allocated to each partition 211. The processor mode 221102 is data indicating if the processor is dedicated to one partition 211 or shared by a plurality of partitions 211. The sharing ratio 221103 is data indicating a ratio of processor throughput for interrupt processing or the like.  
10

15 [0051]

The memory slot number 221104 is data indicating a physical position of the memory allocated to each partition 211. The total memory size 221105 is data indicating a total capacity of the memory allocated to each partition 211. The dedicated memory size 221106 indicates a memory capacity dedicated to each partition 211 out of the total memory size 221105. The shared memory size 221107 indicates a capacity of the memory shared with other partitions 211 out of the total memory size 221105. The shared partition name 221108 is data indicating other partitions that share the memory.  
20

25

[0052]

The input/output device allocation condition 221109 is data indicating which partition 211 only one hardware device such as a

keyboard, a mouse, a display, or the like, existing in the main body of the chassis is presently allocated to.

[0053]

5       The partition configuration information 2211 further comprises computer identification information 221110. The computer identification information 221110 is identification information (for example, a serial number or the like of the computer) that uniquely indicates the computer itself. And, when the partitioning control unit  
10 221 sends information to the management agent 2111, the computer identification information 221110 is always attached to the sent information. The computer identification information 221110 is used by the management console 10 to judge that the computer itself is a partitioning enabled system and each piece of hardware belongs to one  
15 computer, for example.

[0054]

Although not shown in the figure, the partition configuration information 2211 further comprises information for each partition,  
20 which indicates if the partition concerned should be activated at the same time with switch-on of the power supply. Further, in the case that partitions 211 divide and share extended hardware such as a hard disk within the computer, similarly to the examples of the processor and memory, the partition configuration information 2211 keeps  
25 therein information indicating a relation between each piece of extended hardware and each partition.

[0055]

Next, operation of the open-type partitioning enabled system  
20 having the above-described configuration will be described.

[0056]

5 First, initialization process at the time of activation of the  
system will be described.

[0057]

10 Fig. 4 is a diagram showing the flow of initialization process at  
the time of system activation in the open-type partitioning enabled  
system 20. Here, will be described process in which one partition 211  
(for example, the partition A) is activated at the time of system  
activation. When a plurality of partitions are to be activated at the  
time of system activation, those partitions are sequentially activated in  
15 the same manner.

[0058]

When the power supply 23117 of the open-type partitioning  
enabled system 20 is switched on, for example, manually or under an  
20 instruction of the service processor 2313, each piece of the main body  
hardware group 2311 starts to be activated (S1001).

[0059]

Next, the partitioning control unit 221 is activated to decide  
25 hardware to be allocated to each partition, based on the partition  
configuration information 2211 (S1002). The partition configuration  
information 2211 has been set in advance to suitable values  
corresponding to actual conditions, by the administrator through the

management console 10 or a local input device. When the service processor 2313 exists, the service processor 2313 may perform similar process, in stead of the partitioning control unit 221.

5 [0060]

Next, the OS 2110 of the partition A is activated, and further, the management agent 2111, which operates on the OS 2110, is activated (S1003).

10 [0061]

Next, the partition configuration information 2211 is notified to the management console 10, through the communication relay unit 2212 in the partitioning control unit 221, and through the communication unit with partitioning control unit 21115 and the external communication unit 21111 in the management agent 2111 (S1004). At that time, also the computer identification information 221110 is notified to the management console 10.

[0062]

20 On receiving the mentioned information, the management console 10 analyzes the information in question, and displays the fact that the managed computer is an partition enabled system, displays the number of the partitions constituting the managed computer, and displays if each partition 211 is presently in an activated state, on its screen (S1005).

[0063]

Also, in the case that, after the activation of the computer, an

additional partition is individually activated under an instruction from the administrator, the computer identification information 221110 etc. are notified to the management console 10. And, the management console 10 uses the notified computer identification information 221110  
5 to judge if another partition existing in the same computer is activated.

[0064]

Next, operation of acquiring hardware configuration information in the open-type partitioning enabled system 20 will be  
10 described.

[0065]

Fig. 5 is a diagram showing the flow of processing at the time of acquiring hardware configuration information in the open-type partitioning enabled system 20. Here, will be described the case of acquisition of hardware configuration information of one partition 211 (for example, the partition A) in the open-type partitioning enabled system 20.  
15

20 [0066]

First, through the management console 10, the administrator requests acquisition of hardware configuration information from the partition A of the open-type partitioning enabled system 20 (S301).

25 [0067].

When the management agent 2111 on the partition A receives that request through the external communication unit 21111, the management agent 2111 issues a hardware configuration information

acquisition instruction to the partitioning control unit 221 through the communication unit with partitioning control unit 21115 (S302).

[0068]

5       The partition configuration management unit 2213 in the partitioning control unit 221 receives that instruction, and then, the partition configuration management unit 2213 acquires configuration information on all the hardware existing within the open-type partitioning enabled system 20, from the hardware data collection unit  
10      23111 through the communication relay unit 2212 (S303).

[0069]

Then, data on the hardware allocated to the partition A are acquired from the partition configuration information 2211. And,  
15      using that data, only the hardware configuration information related to the partition A is extracted from the configuration information on all the hardware. Then, the extracted hardware configuration information is notified to the management agent 2111 through the communication relay unit 2212 (S304).

20

[0070]

The management agent 211 notifies the hardware configuration information received from the partitioning control unit 221 to the management console 10 through the external communication unit  
25      21111, and the information is displayed on the management console 10 under observation of the administrator (S305).

[0071]

Here, each piece of the hardware configuration information notified to the management agent 211 in the step S304 includes the computer identification information 221110, also. Based on the mentioned information, the management console 10 can know if the 5 information from each partition 211 is information from a partition within the same computer.

[0072]

Hereinabove, the description has been given to the case where 10 configuration information on hardware allocated to one partition is acquired. In the case of a request for acquisition of the hardware configuration information 2211 of the whole computer, the partitioning control unit 221 returns the configuration information on all the hardware to the management agent 2111, without performing the 15 extraction processing in the step S304.

[0073]

Next, will be described processing at the time of occurrence of a hardware failure in the open-type partitioning enabled system 20.

20

[0074]

Fig. 6 is a diagram showing the flow of processing at the time of occurrence of a hardware failure in the open-type partitioning enabled system 20. Here, will be described the case where a failure is 25 generated in the hardware allocated to one partition 211 (for example, the partition A) in the open-type partitioning enabled system 20.

[0075]

First, the hardware data collection unit 23111 monitors the conditions of the sensor devices and each piece of hardware, and, on detecting occurrence of a failure, notifies the information on the detected hardware failure to the partitioning control unit 221 (S401).

5

[0076]

Being notified of the hardware failure information, the partitioning control unit 221 refers to the partition configuration information 2211 in order to specify the partition 211 (for example, the 10 partition A) to which the failure-detected hardware is allocated (S402). Then, the partitioning control unit 221 notifies the information on the detected hardware failure to the management agent 2111 of the specified partition A (S403).

15 [0077]

The hardware failure information notified to the management agent 2111 is delivered to the failure information management unit 21112 through the communication unit with partitioning control unit 21115 to be recorded in the log file 21113, and at the same time, is 20 notified to the management console 10 through the external communication unit 21111 (S404).

[0078]

Receiving the above-mentioned information, the management 25 console 10 displays the notified hardware failure on the screen or the like, to inform the administrator of the occurrence of the hardware failure (S405).

[0079]

Here, when the hardware failure information is notified from the partition control unit 221, the management agent 2111 may perform various control operations on software in the partition 211 in addition 5 to or instead of notifying the failure information in question to the management console 10 in the above step S404. For example, the failure information management unit 21112 may notify the failure information to the OS 2110 or an application operating on the OS 2110, stop the OS 2110 or an application operating on the OS 2110, or 10 perform transfer processing that makes another OS or an application operating on another OS inherit processing under execution by the OS 2110 or an application operating on the OS 2110.

[0080]

15 By performing such processing, it is possible to link with software control when a hardware failure is generated, and it is also possible to realize an autonomous countermeasure processing for a failure. Here, "autonomous" means that the processing is closed within one computer.

20

[0081]

When a hardware failure detected by the hardware data collection unit 23111 is such a fatal failure as to stop the system on the computer, the above-described information transfer is impossible. 25 However, even in such a case, if the computer has the service processor 2313, the failure information can be notified to the management console 10 through the service processor 2313. Further, in the case that a computer has the service processor 2313, even when a hardware

failure detected by the hardware data collection unit 23111 is not fatal, the failure information concerned may be notified to the service processor 2312, to accumulate the failure information in a log management unit provided within the service processor 2313, and, at 5 the same time, to notify the failure information to the management console 10 also from the service processor 2313.

[0082]

Next, will be described processing at the time of occurrence of 10 a software failure in the open-type partitioning enabled system 20.

[0083]

Fig. 7 is a diagram showing the flow of processing at the time of occurrence of a software failure in the open-type partition enabled 15 system 20. Here, will be described the case where a software failure is generated in one partition 211 (for example, the partition A) in the open-type partitioning enabled system 20.

[0084]

First, when the software failure monitoring unit 21114 in the 20 management agent 2111 detects occurrence of a software failure in the OS 2110 or an application operating on the OS 2110, the software failure monitoring unit 21114 notifies the information on the detected software failure to the failure information management unit 21112 25 (S601).

[0085]

The failure information management unit 21112 records the

notified software failure information to the log file 21113, and, at the same time, notifies it to the partitioning control unit 221 through the communication unit with partitioning control unit 21115 (S602). At that time, the software failure information may be notified also to the  
5 management console 10, through the external unit 21111.

[0086]

In the partitioning control unit 221, when the partition configuration management unit 2213 receives the software failure  
10 information through the communication relay unit 2212, the partitioning control unit 221 performs various control operations on the partition 211 (for example, the partition A) where the software failure has occurred (S603). For example, termination processing and re-activation processing for the partition A may be performed, or  
15 hardware reallocation processing for the hardware allocated to the partition A may be performed. When hardware reallocation processing is performed, the partition configuration information 2211 is updated according to the contents of the reallocation.

20 [0087]

By performing such processing, it is possible to link with hardware control when a software failure is generated, and it is also possible to realize an autonomous countermeasure processing for a failure, in the sense that it is closed within one computer.

25

[0088]

Next, will be described processing of dynamic control of the hardware allocated to each partition 211 and processing of

activation/termination of each partition 211, under an instruction from the management console 10, in the open-type partitioning enabled system 20.

5 [0089]

Fig. 8 is a diagram showing the flow of processing of dynamic control of the hardware allocated to each partition 211 or processing of activation/termination of each partition 211, under an instruction from the management console 10, in the open-type partitioning enabled system 20. Here, will be described the case where control instructions are given in relation to one partition 211 (for example, the partition A) in the open-type partitioning enabled system 20.

[0090]

15 First, the administrator uses the management console 10 to issue a processing instruction directed to the partitioning control unit 221 for partitioning control of the open-type partitioning enabled system 20 (S701).

20 [0091]

The issued instruction is transferred to the partitioning control unit 221 through the management agent 2111 or the service processor 2313 (S702).

25 [0092]

In the partitioning control unit 221 that has received the instruction, the partition configuration management unit 2213 performs dynamic control of the hardware allocated to the partition A

or activation/termination control of the partition A, according to the contents of the instruction (S703). Here, when hardware reallocation processing is performed, the partition configuration information 2211 is updated according to the contents of reallocation.

5

[0093]

Here, it is possible that the partitioning control unit 221 performs dynamic control or the like of the hardware allocated to each partition 211, based on not only an instruction from the management console 10, but also hardware failure information notified from the hardware data collection unit 23111.

[Second Embodiment]

Next, another configuration of the open-type partitioning enabled system will be described.

[0094]

Fig. 9 is a diagram showing another configuration of the open-type partitioning enabled system. This figure shows also a configuration required for performing configuration management, failure monitoring, and control of hardware resources. As shown in the figure, the open-type partitioning enabled system 20a comprises a plurality of partitions 211 (A - N), a management-dedicated partition 240, a partitioning control unit 221, and hardware 231.

25

[0095]

Differences from the configuration shown in Fig. 2 lie in that the management-dedicated partition 240 is provided, and that each

partition 211 other than the management-dedicated partition 240 is provided with a software management agent 2113 instead of the management agent 2111.

5 [0096]

The partitioning control unit 221 and the hardware 231 have the similar configurations as those shown in Fig. 2.

[0097]

10 The management-dedicated partition 240 is one of a plurality of partitions provided in the open-type partitioning enabled system 20a, and is operated for management of the whole computer.

[0098]

15 On the management-dedicated partition 240, a management OS 2410, which assures real time operation (hereinafter, referred to as RAS-OS), and an integrated management agent 2411 operate and communicate with the management console 10.

20 [0099]

The RAS-OS 2410 is an OS that enables real time control, and is allocated with the minimum resources and always continues to operate as far as the partitioning enabled system operates.

25 [0100]

The integrated management agent 2411 operating on the RAS-OS 2410 cooperates with the software management agents 2113 operating respectively on the partitions 211, the partitioning control

unit 221, and the hardware data collection unit 23111, to realize configuration management, failure monitoring and control of the whole computer.

5 [0101]

As shown in Fig. 9, the integrated management agent 2411 comprises an external communication unit 21111, a failure information management unit 21112, a log file 21113 and a communication unit with partitioning control unit 21115. The external communication unit 21111, the failure information management unit 21112, the log file 21113 and the communication unit with partitioning control unit 21115 are respectively similar to the external communication unit 21111, the failure information management unit 21112, the log file 21113 and the communication unit with partitioning control unit 21115 provided to 10 the management agent 2111 shown in Fig. 2.

15 [0102]

Further, the software management agent 2113 comprises a software failure monitoring unit 21114 and a communication unit with 20 partitioning control unit 21115. The software failure monitoring unit 21114 and the communication unit with partitioning control unit 21115 are respectively similar to the software monitoring unit 21114 and the communication unit with partitioning control unit 21115 provided to the management agent 2111 shown in Fig. 2.

25

[0103]

The software management agent 2113 monitors a software failure of the OS 2110 or an application operating on the OS 2110, and

communicates with the partitioning control unit 221 but does not directly communicate with the management console 10.

[0104]

5        In the open-type partitioning enabled system 20a shown in Fig. 9, the integrated management agent 2411 utilizes the partitioning control unit 221 and the hardware data collection unit 23111 to perform configuration management, failure monitoring, and control of the hardware of all the partitions, which includes all the hardware existing  
10      in the computer.

[0105]

15      In other words, the integrated management agent 2411 takes all the tasks assumed by the respective management agents 2111 on the partitions 211 in the open-type partitioning enabled system shown in Fig. 2.

[0106]

20      For example, hardware failure information detected by the hardware data collection unit 23111 is notified to the integrated management agent 2411 through the partitioning control unit 221. Receiving that notification, the integrated management agent 2411 notifies the received failure information to the management console 10, or performs control of the software, in cooperation with the software  
25      management agents 2113.

[0107]

Further, information on a software failure occurred in each

partition 211 is notified by the software management agent 2113 on the partition 211 in question to the integrated management agent 2411 through the partitioning control unit 221.

5 [0108]

The processing flows of the configuration management, failure monitoring and control of the hardware using the integrated management agent 2411 are basically similar to the above-described processing flows shown in Figs. 4 - 8.

10

[0109]

[Effects of the Invention]

As described in detail above, the present invention can realize configuration management, failure monitoring and control of hardware in an open-type computing system in which a plurality of OSs run.

[Brief Explanation of the Drawings]

[Fig. 1]

Fig. 1 is a diagram showing an example of configuration of a computing system to which the present invention is applied.

[Fig. 2]

Fig. 2 is a diagram showing a management configuration of an open-type partitioning enabled system.

[Fig. 3]

Fig. 3 is a diagram showing an example of structure of partition configuration information 2211.

[Fig. 4]

Fig. 4 is a diagram showing the flow of initialization process at

the time of activation of the system.

[Fig. 5]

Fig. 5 is a diagram showing the flow of processing at the time of acquiring hardware configuration information.

5 [Fig. 6]

Fig. 6 is a diagram showing the flow of processing at the time of occurrence of a hardware failure.

[Fig. 7]

Fig. 7 is a diagram showing the flow of processing at the time 10 of occurrence of a software failure.

[Fig. 8]

Fig. 8 is a diagram showing the flow of processing for performing control etc. of hardware under an instruction from a management console.

15 [Fig. 9]

Fig. 9 is a diagram showing another management configuration of an open-type partitioning enabled system.

#### [Explanation of Reference Signs in Drawings]

- 20      10 ... management console
- 20 ... open-type partitioning enabled system
- 30 ... open-type partitioning disabled system
- 40 ... mainframe-type partitioning enabled system
- 50 ... mainframe-type partitioning disabled system
- 25      60 ... network
- 211 ... partition
- 2110 ... operating system
- 2111 ... management agent

- 2113 ... software management agent
- 21111 ... external communication unit
- 21112 ... failure information management unit
- 21113 ... log file
- 5        21114 ... software failure monitoring unit
- 21115 ... communication unit with partitioning control unit
- 221 ... partitioning control unit
- 2211 ... partition configuration information
- 2212 ... communication relay unit
- 10      2213 ... partition configuration management unit
- 231 ... hardware
- 2311 ... main body hardware group
- 2313 ... service processor
- 23111 ... hardware data collection unit
- 15      23112 ... processor
- 23113 ... processor temperature sensor
- 23114 ... processor fan
- 23115 ... memory
- 23116 ... input/output device
- 20      23117 ... power supply
- 23118 ... power supply fan
- 23119 ... voltage sensor
- 23120 ... chassis fan
- 23121 ... chassis temperature sensor
- 25      240 ... management-dedicated partition
- 2410 ... management operating system
- 2411 ... integrated management agent

[Document's Name]

### Abstract

[Abstract]

5 [Problems]

Configuration management, failure monitoring and control of hardware resources are realized in an open-type computer on which a plurality of OSs run...

10 [Means to Solve the Problems]

A management agent 2111 operating on each partition 211 performs communication with a management console 10, management of information on hardware or software failure occurred in each partition 211, and communication with a partitioning control unit 221.

- 15 The partitioning control unit 221 utilizes partition configuration information 2211 to manage and control hardware allocated to each partition 211, and to intermediate communication between the hardware 231 and the management agents 2111. A hardware data collection unit 23111 manages information on configuration of all the  
20 hardware in the computer, and monitors conditions of and a failure in the hardware.

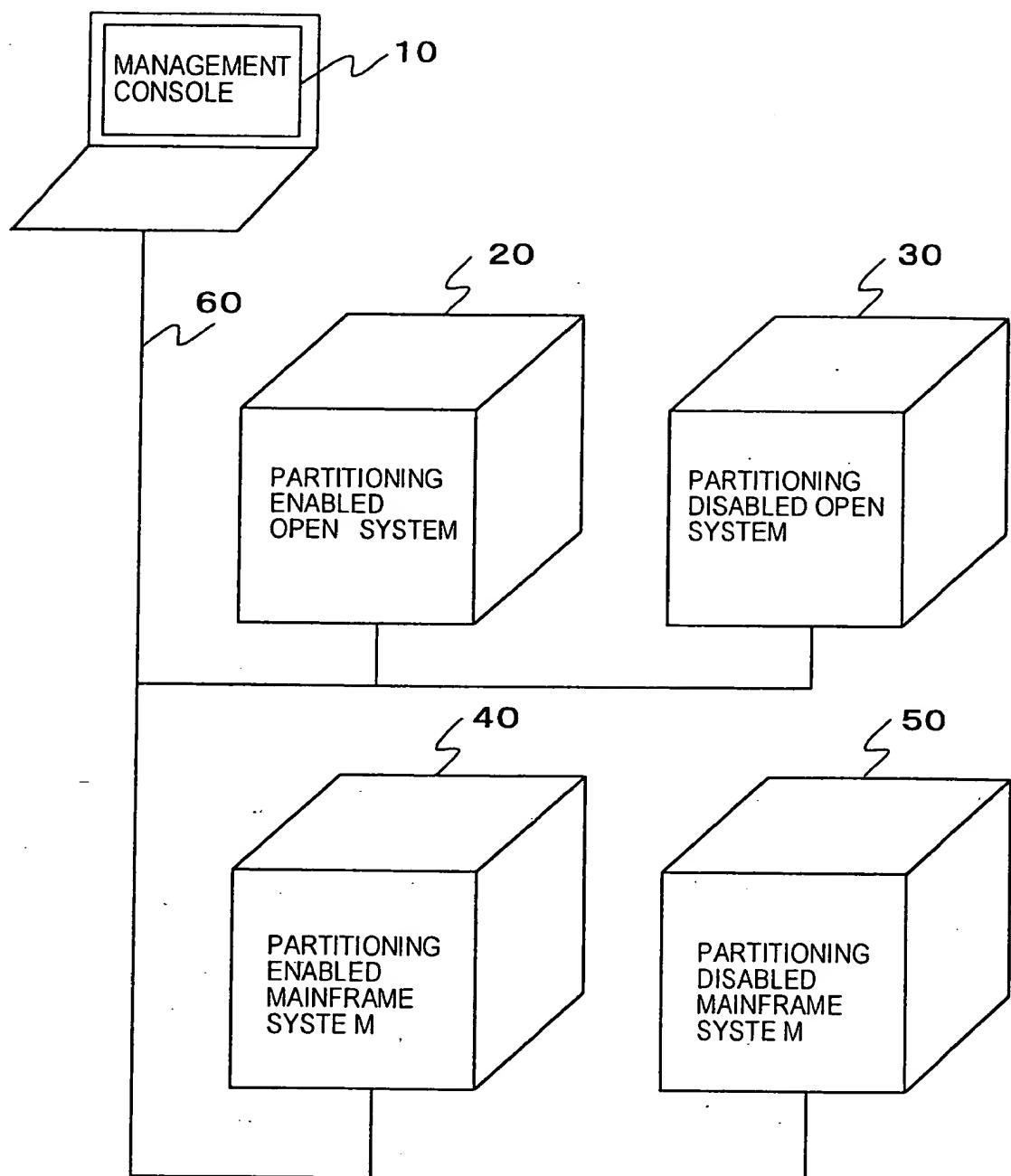
[Selected Figure]

Fig. 2

OIPE  
DEC 13 2004  
SEARCHED INDEXED SERIALIZED FILED  
STANFORD UNIVERSITY LIBRARIES

1/8

# FIG.1



OIPE  
DEC 13 2004  
SEARCHED INDEXED SERIALIZED FILED  
JCB

2/8

FIG.2

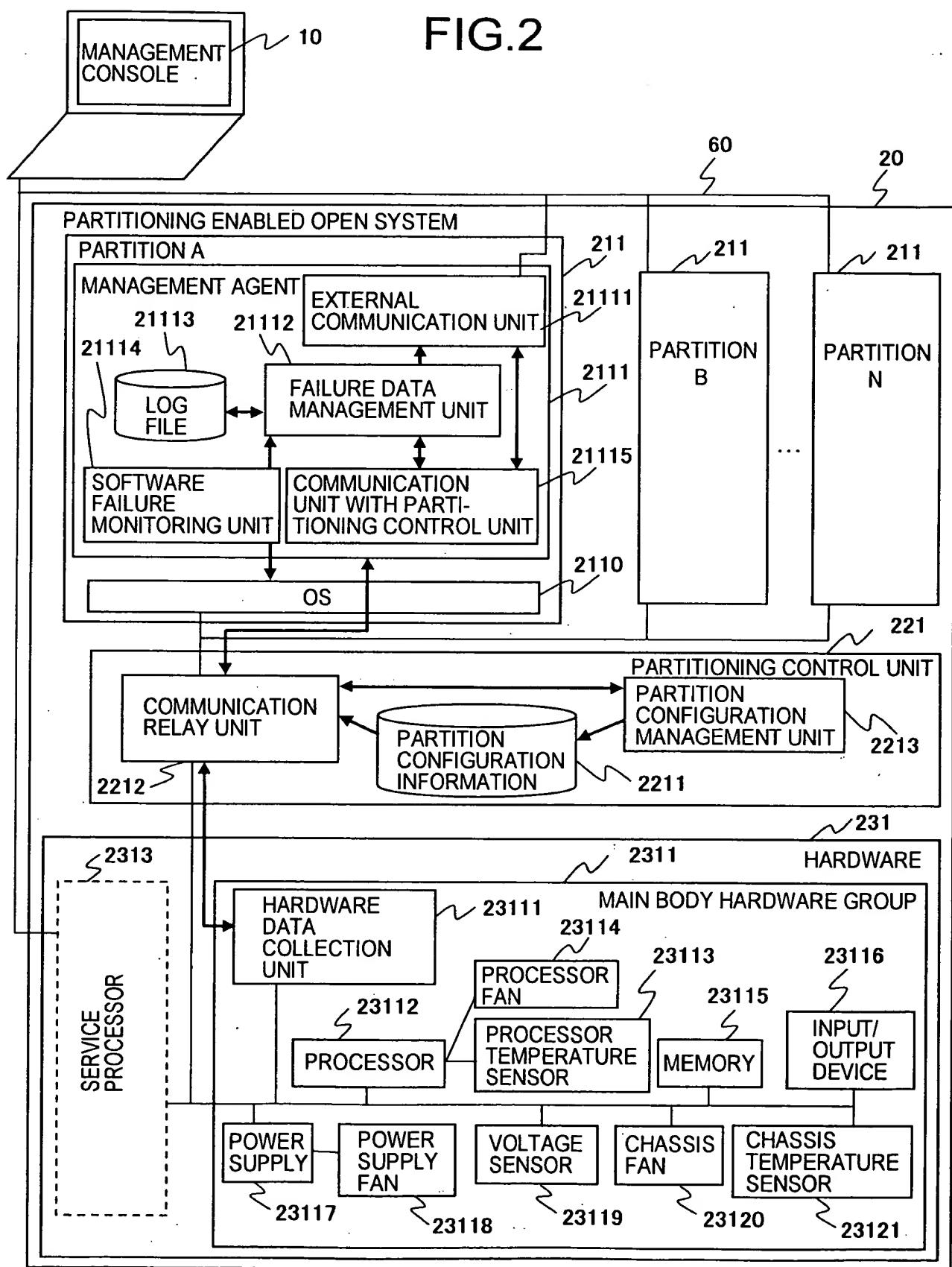




FIG.3

211

	PROCESSOR			MEMORY					
	NUMBER	MODE	SHARING RATIO	SLOT NUMBER	TOTAL SIZE	DEDICATED SIZE	SHARED SIZE	JOINT PARTITION	
PARTITION A	1	SHARED	80%	1,2	256MB	128MB	128MB	D	
PARTITION B	1	SHARED	20%	3	128MB	0MB	128MB	D	
PARTITION C	2	DEDI-CATED	-	4	128MB	128MB	0MB		
PARTITION D	3,4	SHARED	-	2,3,5	384MB	128MB	256MB	A,B	
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
PARTITION N									
COMPUTER IDENTIFICATION INFORMATION (CHASSIS IDENTIFICATION NUMBER) : 000001									

221110



FIG.4

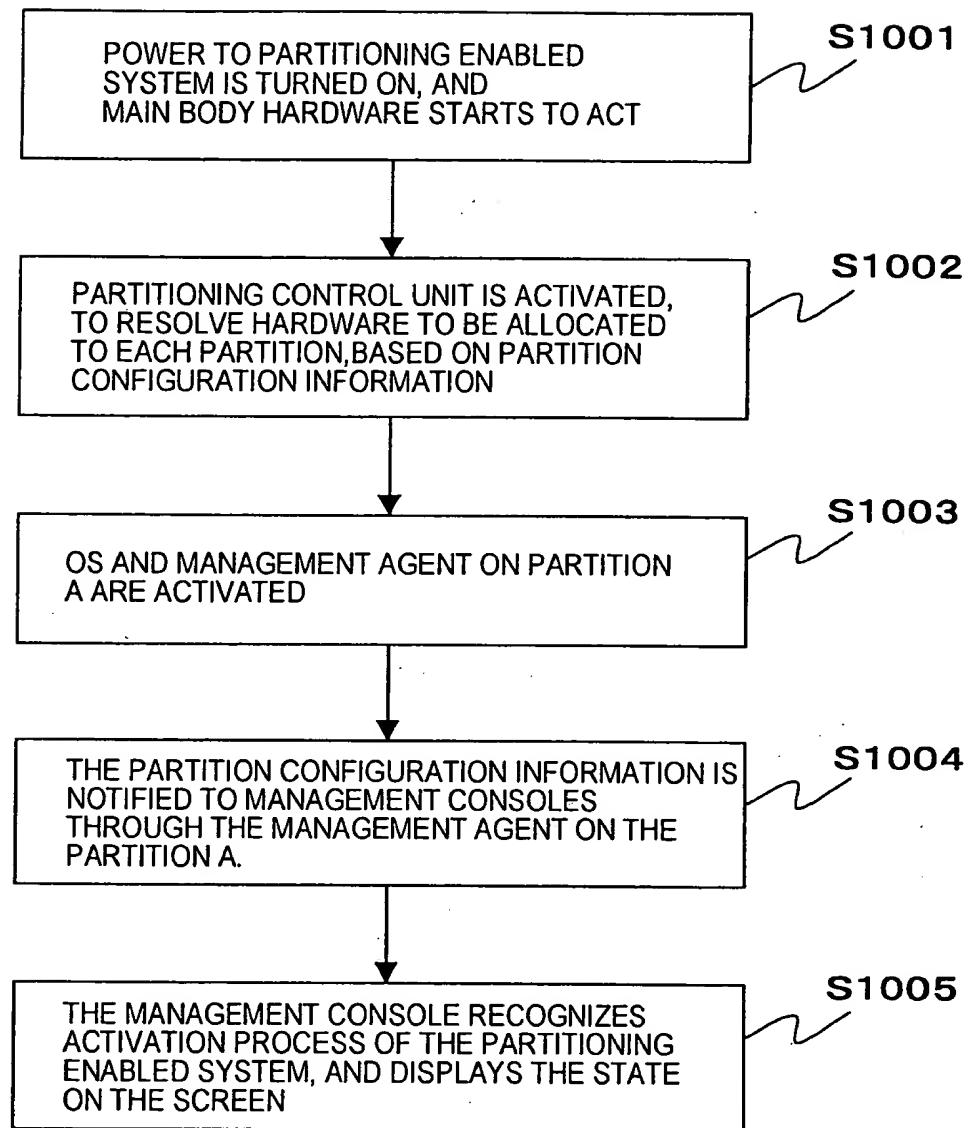


FIG.5

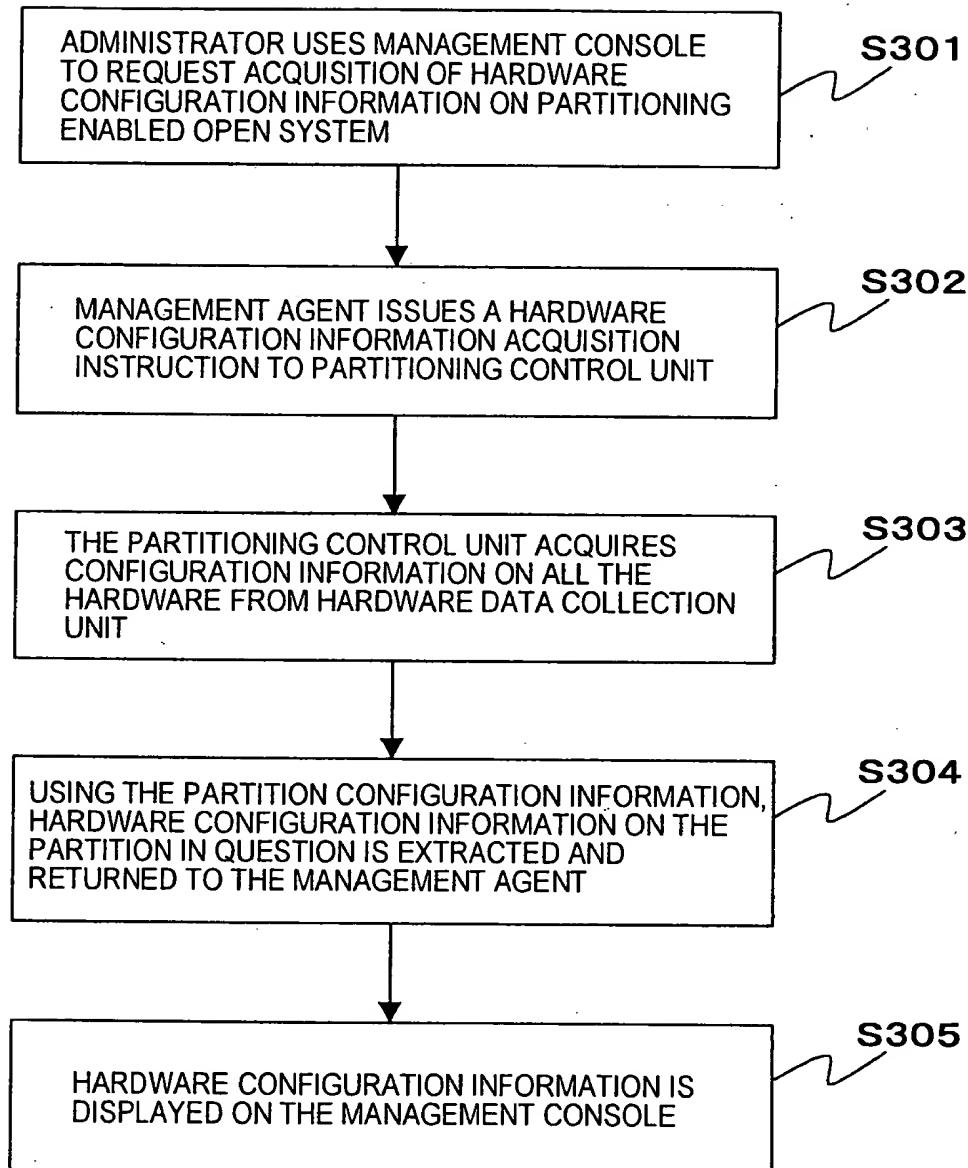


FIG.6

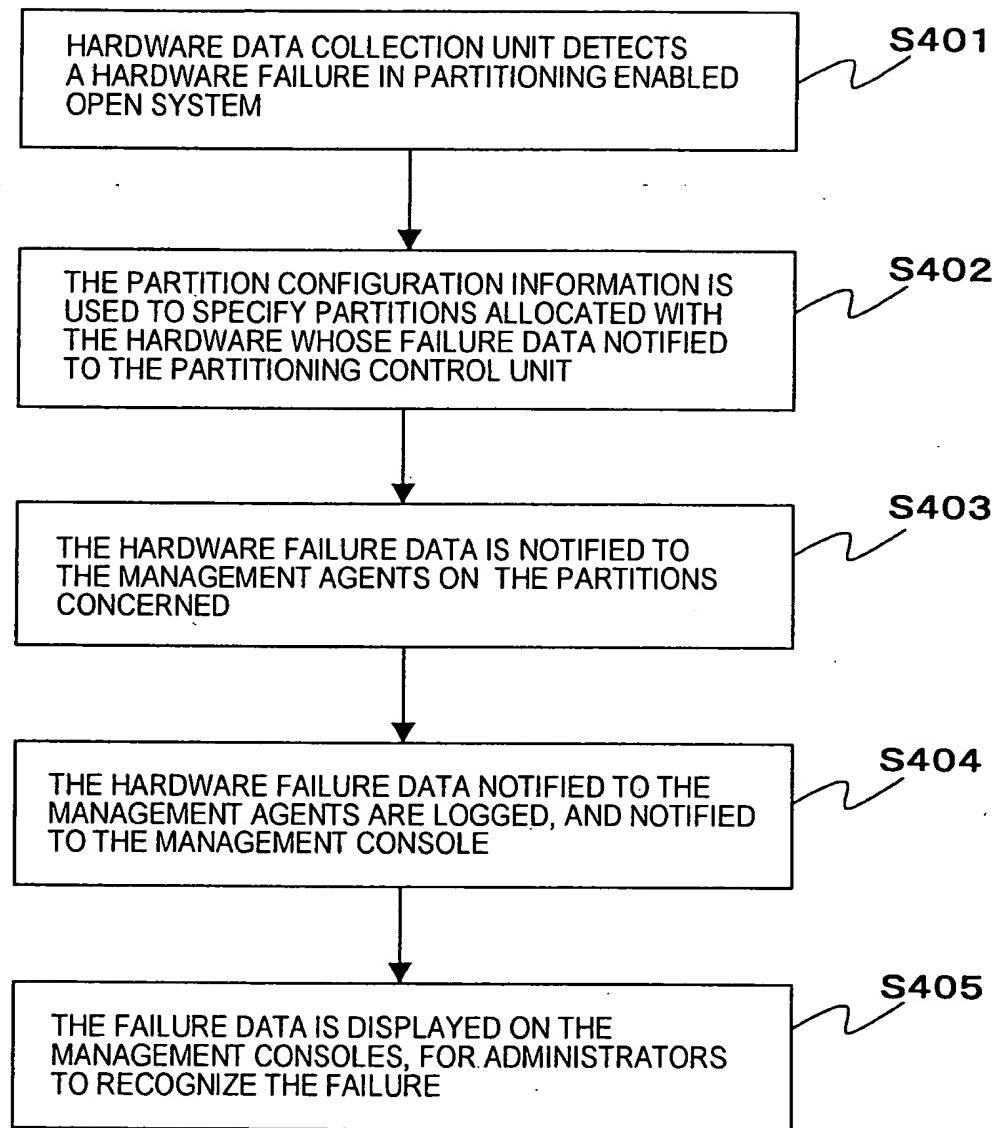


FIG.7

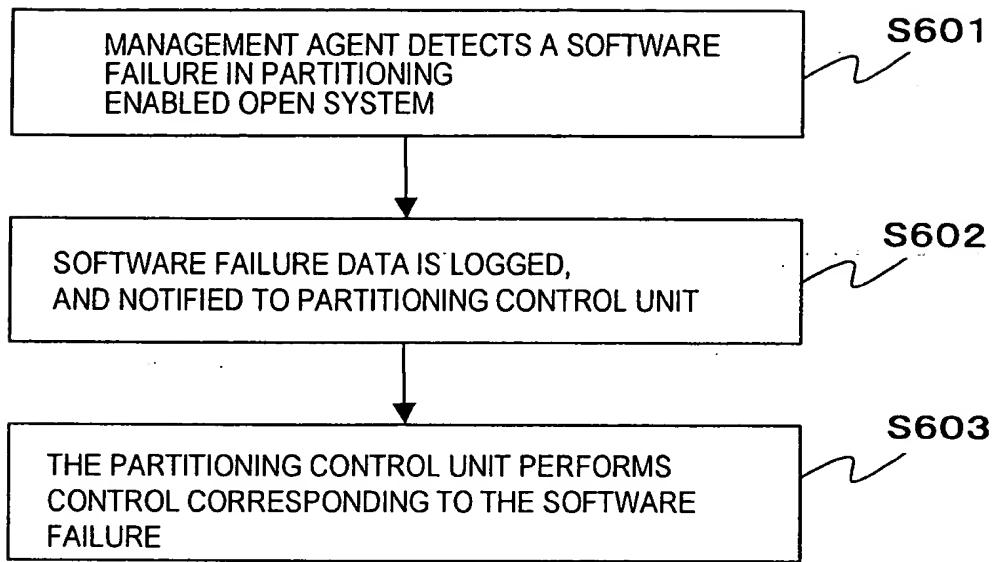


FIG.8

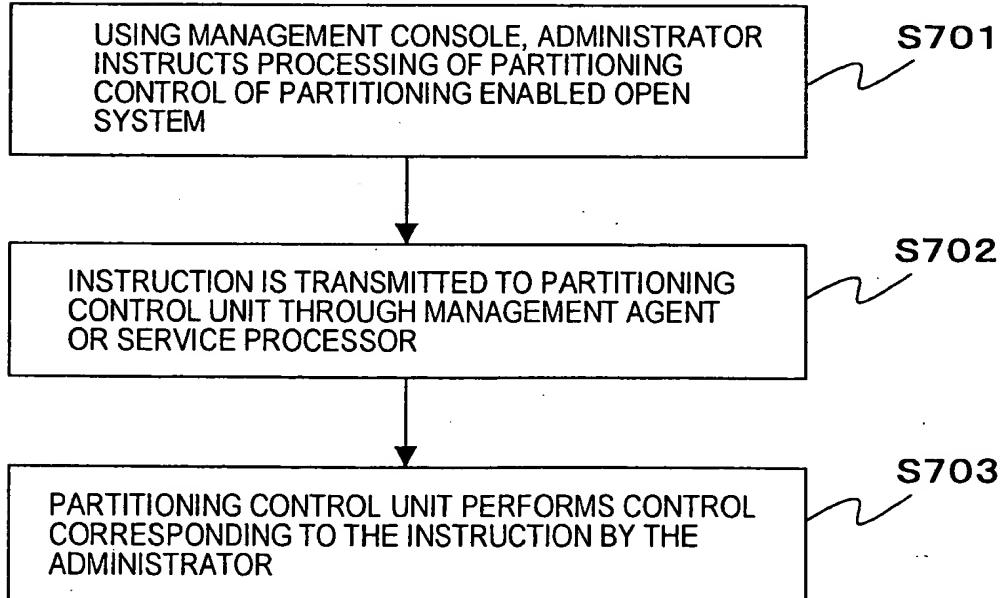


FIG.9

